



Valve Device for a Pneumatic Suspension Unit of a Vehicle VALVE DEVICE FOR A  
PNEUMATIC SUSPENSION UNIT OF A VEHICLE

BACKGROUND OF THE INVENTION

The present invention relates to a new valve device according to the preamble of claim 1, for an a vehicle air-suspension device for a vehicle system.

A valve device of the class in question is known from German Patent general type under consideration is described in DE 4202729 A1.

Air-suspension devices systems for vehicles are usually provided with a device for regulating the level of the vehicle body relative to the chassis or to the roadway. As regards such level-regulating devices, a distinction is made between two principles, one being a level-regulating devices that operates purely mechanically by means of an air-suspension valve and the other an electronically-controlled level-regulating devices. A mechanically-controlled level-regulating device containing an air-suspension valve is known, for example, from the aforesaid prior art DE 4202729 A1. An example of an known electronically-controlled level-regulating device can be found in European Patent EP 0779167 B1.

In mechanically-controlled level-regulating devices containing having an air-suspension valve, a manually actuatable valve, which is often also referred to as a rotary slide valve, is usually provided in addition to the air-suspension valve. By means of the rotary slide valve, an operator can bypass the air-suspension valve and adjust the desired relative level of the vehicle body manually; by placing this the rotary slide valve in the "Raise", "Lower" or "Stop" positions. In this way, there can be achieved a the relative level needed, for example, for

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loading the vehicle at a loading dock, can be achieved. ~~Such a~~ The rotary slide valve is additionally may also be provided with a “Travel” position, in which the air-suspension valve becomes active once again. ~~In the prior art cited in the foregoing, a~~ An electromagnetically actuable valve ~~is additionally~~ may also be provided for resetting the manual valve from the “Stop” position to the “Travel” position.

In electronically ~~controlled~~ level-regulating devices, control of the relative level takes place in any case via electromagnetically actuable valves, both in the case of electronic regulation of the relative level and in the case of manual adjustment via an electrical operating unit.

Despite the ~~persuasive advantages~~ of electronically-controlled level-regulating devices over mechanically-controlled level-regulating devices, such as considerably better regulation comfort and greater driving safety by virtue of refined regulation algorithms ~~offered by an electronically controlled level-regulating device compared with the embodiment containing an air-suspension valve,~~ air-suspension valves associated with mechanically-controlled level-regulating devices are still being used ~~in practice~~ for cost-saving reasons.

### SUMMARY OF THE INVENTION

Generally speaking, in accordance with ~~The object of the present invention is~~ therefore ~~to provide, for an air-suspension device for a vehicle,~~ a new valve device for a vehicle air-suspension system is provided that can be used simply and inexpensively ~~both in both a mechanically-controlled level-regulating devices containing an air-suspension valve and in an electronically-controlled level-regulating devices.~~ The valve device according to a preferred

embodiment of the present invention includes a manually actuatable aeration valve for aerating the air-suspension bellows of the air-suspension system, a manually actuatable bleed valve for bleeding the air-suspension bellows, and a first electrically actuatable valve. The aeration valve, bleed valve and first electrically actuatable valve are disposed in a common housing. A second electrically actuatable valve is also disposed in the housing.

~~This object is achieved by the invention specified in claim 1. Improvements and advantageous configurations of the inventions are specified in the dependent claims.~~

~~The~~Advantageously, the present invention has the advantage that it offers an inexpensive, universal solution ~~both for both mechanically-controlled level-regulating devices containing an air-suspension valve and for electronically-controlled level-regulating devices.~~ The present invention can be manufactured as a compact valve block, which ~~either can~~ either be sold separately or ~~can be sold as~~ a compact electronic level-regulating unit combined with an electronic control device. As a result of the universal usability of the valve device, The cost benefit of the present inventive valve devices compared with over different conventional valve devices for the different principles of the level-regulating devices are ~~is~~ achieved in series production, ~~since whereby~~ the inventive valve device can be manufactured in relatively high output volume by virtue of its universal ~~usability~~applicability.

~~A further~~An additional advantage of the present invention is that a vehicle equipped ~~originally with an~~the inventive valve device as well as with an air-suspension valve ~~in order to satisfy cost reasons can be retrofitted with relatively little~~ minimal time and effort with an electronically controlled level-regulating device. For this purpose, the inventive valve device can be ~~is~~ retained, ~~while but~~ the air-suspension valve ~~merely has to be~~is replaced by what is

~~known as~~ a displacement sensor for sensing the relative level of the vehicle body. Furthermore, the inventive valve device can be connected electrically to an electronic control device. ~~Such a necessary~~ Usually, the electronic control device is ~~usually~~ already present in the vehicle, for example, in the form of an electronics module, ~~which is provided~~ for an anti-brake-lock system, and ~~also~~ has connections appropriate for the inventive valve device and the displacement sensor.

For application of the inventive valve device in an electronically controlled level-regulating device, a further advantage ~~exists in~~ is that ~~there are already provided~~ manual operating elements are already provided for admitting air into and venting air from ~~the~~ air suspension bellows, or in other words for manually changing the relative level of the vehicle body. ~~Hereby~~ As a result, manual change of relative level is possible even in the absence of power supply to the electronically controlled level-regulating device. A further advantage in this regard is that there is no need, especially for trailer vehicles, to provide an on-board battery or to externally supply a parked trailer vehicle ~~externally~~ with power by some other means; in order to ~~be able to~~ change the relative level manually, for example, at a loading dock.

For application of the inventive valve device in a mechanically-controlled level-regulating device ~~containing an air suspension valve~~, a ~~further~~ an additional advantage exists in that there is already provided an electrically actuatable valve, by means of which the regulating function of the air-suspension valve can be turned off, for example when the vehicle is stationary, in order to permit a manual change of the relative level, ~~and by means of which~~ The electrically actuatable valve also allows the air-suspension valve ~~can to~~ be reactivated when the vehicle starts to travel once again, ~~in order to ensure~~ thus ensuring a relative level that is safe for driving operation of the vehicle.

According to ~~an advantageous improvement~~ one embodiment of the present invention, a relay valve is further provided. Relay valves can be manufactured relatively inexpensively, and they offer a large flow cross section for admission of air into and venting of air from the air-suspension bellows, thus permitting relatively rapid changes of relative level. According to ~~an advantageous improvement~~ an embodiment of the present invention, the relay valve is disposed in the housing of the inventive valve device. ~~Hereby there can be achieved enabling a compact construction of the valve device.~~ In addition, An advantage of this construction is that separate compressed-air lines to the relay valve do not have to be ~~laid~~ used during installation of the present inventive valve device in the vehicle.

According to ~~an advantageous improvement~~ another embodiment of the present invention, a contactlessly operating displacement sensor for sensing the distance of the inventive valve device ~~from~~ relative to the roadway is further provided and disposed in the housing. ~~As an example, t~~ The displacement sensor can be configured as an ultrasonic sensor, as a radar sensor or as a sensor operating according to the light-reflection principle. Because the displacement sensor is disposed in the housing of the inventive valve device, ~~and because the valve device which is usually mounted on the vehicle, usually on the vehicle frame, the said sensor is already mounted at a location suitable for transmitting a signal characteristic of the relative level of the vehicle body.~~ Thus, there is no need for separate mounting to separately mount and enabling provide cables to of the displacement sensor.

Still other objects and advantages of the present invention will in part be obvious and will in part be apparent from the specification.

The present invention accordingly comprises the features of construction,

combination of elements, and arrangements of parts which will be exemplified in the constructions hereinafter set forth, and the scope of the invention will be indicated in the claims.

### BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be explained-described in more detail hereinafter and further advantages will be pointed out on the basis of practical examples, using drawings, wherein the accompanying drawings, in which:

Fig. 1 shows is a schematic diagram depicting a vehicle air suspension system employing a first embodiment of the inventive valve device according to one embodiment of the present invention for use in an electronically-controlled level-regulating device; and

Fig. 2 is a schematic diagram depicting a vehicle air suspension system employing shows the application of the aforesaid valve device according to Fig. 1 in a mechanically-controlled level-regulating device; containing an air suspension valve, and

Fig. 3 shows is schematic diagram depicting a second embodiment of the inventive valve device according to another embodiment of the present invention; and

Fig. 4 shows is a schematic diagram depicting a third embodiment of the inventive valve device according to a further embodiment of the present invention.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In Referring now to the drawing figures, where like reference numerals are used for parts corresponding to one another,;

Fig. 1, The shows a vehicle air-suspension device-system for a vehicle illustrated in Fig. 1 is provided with air-suspension bellows (3), which are present in the vehicle in order to

brace the vehicle body relative to the wheels (4) or to the axles of the vehicle. The air-suspension ~~device-system~~ is also provided with an electronically controlled level-regulating device (1, 5, 22, 23), which, for admission of air to air-suspension bellows (3), controls a compressed-air supply flow from a pressurized-fluid source (2) in communication with the level-regulating device to air-suspension bellows (3), and, for venting of air-suspension bellows (3), controls a compressed-air discharge flow from air-suspension bellows (3) into the atmosphere.

Electronically controlled level-regulating device (1, 5, 22, 23) is provided with an electronic control device in the form of an electronic control unit (5), which can be supplied by an electrical energy source (~~not illustrated in Fig. 1~~shown). From a displacement sensor (22), which is used to measure the distance of the vehicle body from a reference point relative to wheels (4) and ~~which in this way determines to~~ determine the relative level of the vehicle body, electronic control unit (5) receives a relative-level signal via an electrical line. Displacement sensor (22) can be configured, for example, as an ultrasonic sensor, ~~as a radar sensor or as a~~ sensor operating according to the light-reflection principle.

Furthermore, electronic control unit (5) receives a pressure signal from a pressure sensor (23), via an electrical line. Pressure sensor (23) is in communication on the pressure side with air-suspension bellows (3). Thus, the transmitted pressure signal indicates the air pressure present in air-suspension bellows (3).

Electronic control unit (5) is connected via electrical lines (8, 9) to a valve device (1). Valve device (1) is provided with a housing (55); in which there are disposed a manually actuatable air-admission valve (10) for admission of air to the air-suspension bellows (3), a manually actuatable vent valve (11) for venting air-suspension bellows (3), a first valve (7) that

can be electrically actuated via line (9) and a second valve (6) that can be electrically actuated via line (8). Electrically actuatable valves (6, 7) can be actuated ~~by using~~ by using electronic control unit (5); by energizing electromagnets (20, 21) ~~respectively via~~ respectively via electrical lines (8, 9), respectively.

According to an ~~advantageous improvement~~ embodiment of the present invention, housing (55) is provided with separate compressed-air ports (52, 54) for supplying compressed air from a pressurized-fluid source (2) to electrically actuatable valves (6, 7) on the one hand and to manually actuatable valves (10, 11) on the other hand. ~~Hereby~~ As a result, valve device (1) ~~can be used particularly flexibly~~ is flexible as to varying uses.

For ~~application use~~ of valve device (1) in an electronically controlled level-regulating device such as illustrated in Fig. 1, compressed-air ports (52, 54) are ~~advantageously~~ in communication with one another. For this purpose, first electrically actuatable valve (7) is in communication with pressurized-fluid source (2) via compressed-air port (52). Furthermore, manually actuatable air-admission valve (10) is in communication with pressurized-fluid source (2) via compressed-air port (54).

In accordance with one advantageous configuration ~~another embodiment~~ of the present invention, electronic control unit (5) as well as pressure sensor (3) ~~are additionally~~ is also disposed in housing (55). ~~Hereby there is achieved~~ As a result, a compact electronically-controlled level-regulating device, which can be installed with ~~little~~ minimal time and effort in a vehicle, is provided. According to a further ~~advantageous configuration~~ embodiment of the present invention, displacement sensor (22) is ~~additionally~~ also disposed in housing (55). ~~Hereby there can be achieved a further reduction~~ reducing of the time and effort for installation if needed to install the level-regulating device in the vehicle.

Using predefined algorithms, electronic control unit (5) ~~ascertains~~ determines whether the measured relative level of the vehicle body would necessitate admission of air to or venting of air from air-suspension bellows (3) in order to maintain a desired index relative level. ~~Thereupon by~~ By actuating electrically actuatable valves (6, 7), ~~it~~ electronic control unit (5) ~~brings about admission of~~ supplies air to or ~~venting of~~ vents air from air-suspension bellows (3) as needed, in order to adapt the relative level measured by ~~means of~~ displacement sensor (22) compared to the index relative level.

Valve (6), which in a preferred embodiment is designed as a 3/2 directional control valve, is used as a combined inlet/outlet valve, which assumes an inlet position in the de-energized state of electromagnet (20), as illustrated in Fig. 1, and an outlet position in the energized state of electromagnet (20). Valve (7), which in a preferred embodiment is designed as a 2/2 directional control valve, is used as a holding valve, which assumes a shutoff position in the de-energized state of electromagnet (21), as illustrated in Fig. 1, and a passing position in the energized state of electromagnet (21). For admission of air to air-suspension bellows (3), electronic control unit (5) switches inlet/outlet valve (6) to inlet position and ~~additionally~~ switches holding valve (7) to passing position. ~~Hereby~~ As a result, pressurized-fluid source (2) is placed in communication with air-suspension bellows (3), so that compressed air can flow from pressurized-fluid source (2) via compressed-air lines (13, 15, 17) and valves (6, 7) into air-suspension bellows (3). For venting of air-suspension bellows (3), electronic control unit (5) switches inlet/outlet valve (6) to outlet position and additionally switches holding valve (7) to shutoff position. ~~Hereby~~ As a result, pressurized-fluid source (2) is shut off and air-suspension bellows (3) are placed in communication with a vent port of inlet/outlet valve (6), so that

compressed air can flow from air-suspension bellows (3) via compressed-air line (17) and valve (6) into the atmosphere. To hold the air pressure present in air-suspension bellows (3), electronic control unit (5) switches holding valve (7) to shutoff position and inlet/outlet valve (6) to inlet position.

In the vehicle air-suspension device system illustrated in Fig. 1, all-air-suspension bellows (3) ~~are may be~~ controlled together ~~and always to~~ have the same pressure. ~~It is also common practice~~ Alternatively, it is possible to combine the air-suspension bellows into wheel groups or axle groups or even to control each air-suspension bellows individually. ~~In such a ease~~ the event that suspension bellows are not controlled all together, the electronically-controlled level-regulating device must be augmented by appropriate valves for individual control of the air-suspension bellows or the groups of air-suspension bellows.

In addition, ~~to the already explained parts of the vehicle air-suspension device system is further, there are provided, with a manual actuating elements,~~ two momentary-contact switches (18, 19), as manual actuating elements. ~~By manual actuation of the momentary-contact switches (18, 19), which admission of supplying air to and/or venting of air from~~ air-suspension bellows (3) is possible even in the absence of power supply to electronically controlled level-regulating device (1) or to electronic control unit (5).

According to ~~an advantageous configuration~~ an embodiment of the present invention, valves (10, 11), which can be manually actuated via manual actuating elements (18, 19), are provided in a compressed-air branch (12, 14, 16) ~~that is parallel to and bypassing~~ electrically actuatable valves (6, 7) ~~and bypasses electrically actuatable valves (6, 7).~~ Manually actuatable valves (10, 11) are ~~advantageously designed as~~ preferably a pneumatic 2/2

directional control valve (10) and a pneumatic 3/2 directional control valve (11), respectively. Such directional control valves can be manufactured simply and inexpensively and are highly reliable in use.

According to ~~an advantageous configuration~~ an embodiment of the present invention, momentary-contact switches (18, 19) are mechanically connected ~~mechanically~~ to pneumatic directional control valves (10, 11). Via momentary-contact switches (18, 19), directional control valves (10, 11) ~~respectively~~ can be actuated against to counteract the force of from a restoring spring. Directional control valve (10) then acts as an air-admission valve, which assumes a shutoff position in the non-actuated state of momentary-contact switch (18), as illustrated in Fig. 1, and an inlet position in the actuated state of momentary-contact switch (18). Directional control valve (11) then acts as a combined vent valve, which assumes a passing position in the non-actuated state of momentary-contact switch (19), as illustrated in Fig. 1, and a venting position in the actuated state of momentary-contact switch (19).

In the absence of power supply, ~~a manual change of~~ the relative level can be ~~achieved~~ manually changed by admitting air to or venting air from air-suspension bellows (3) as follows: described hereinafter.

For air admission, momentary-contact switch (18) is manually actuated, ~~meaning~~ that whereby directional control valve (10) is ~~set~~ switched to an inlet position. ~~Hereby~~ As a result, compressed air can flow from pressurized-fluid source (2) via compressed-air lines (12, 14, 16) through directional control valve (10) as well as through directional control valve (11), which is in passing position in the non-actuated state of momentary-contact switch (19), to air-suspension bellows (3). ~~If it is desired to~~ To hold the air pressure or the relative level, momentary-

contact switch (18) is ~~merely released, whereby shutting off~~ the flow of pressurized fluid ~~is shut off~~. For venting, momentary-contact switch (19) is manually actuated, ~~meaning that whereby~~ directional control valve (11) is set to a venting position. ~~Hereby~~ As a result, compressed air can flow out of air-suspension bellows (3) via compressed-air line (16) and via a vent port of directional control valve (11) into the atmosphere. ~~If it is desired to~~ To hold the air pressure or the relative level beginning from this state, momentary-contact switch (19) is ~~merely released~~.

Referring now to Fig. 2, shows the ~~there is illustrated~~ use of the valve device (1) ~~explained in the foregoing~~ in an air-suspension device containing an air-suspension valve (53). In this ~~application~~ embodiment of valve device (1), ~~it is obvious that~~ compressed-air ports (52, 54) are not in communication with one another. Compressed-air port (52) is connected to air-suspension valve (53), which in turn is connected to pressurized-fluid source (2). Compressed-air port (54) is directly connected to pressurized-fluid source (2). ~~Hereby~~ As a result, it is possible ~~on the one hand~~ to change the relative level manually by actuating momentary-contact switches (18, 19), as ~~explained in the foregoing~~ described above, while bypassing air-suspension valve (53).

Air-suspension valve (53) is in communication with the air-suspension bellows via electrically actuatable valves (6, 7). In this ~~application~~ embodiment of valve device (1), electrically actuatable valve (7) is connected, via electrical line (9), to an electronic control device (5), which ~~in this case is designed as~~ is an electronics module already present in the vehicle for other purposes.

As an example, electronics module (5) ~~executes~~ may execute the functions of an anti-brake-lock system; and, for this purpose, is connected via electrical lines (51) to speed

sensors (50) for measuring the speeds of revolution of wheels (4). ~~as well as~~ The electronics module (5) is also connected to brake-pressure regulating valves (not ~~illustrated~~ shown). In addition, electronics module (5) has connections appropriate for valve device (1) and displacement sensor (22). Electronics module (5) evaluates the signals of speed sensors (50) and extracts therefrom a signal indicating whether the vehicle is stationary or traveling. In the stationary mode, electronics module (5) switches electrically actuatable valve (7) to a shutoff position, thus disabling air-suspension valve (53). ~~If the vehicle is i~~ In the travel mode, electronics module (5) switches electrically actuatable valve (7) to a passing position, ~~such~~ so that air-suspension valve (53) is placed in communication with air-suspension bellows (3) and can regulate the level of the vehicle body. Electrically actuatable valve (6) is not used in this application of valve device (1).

According to ~~a further advantageous configuration~~ another embodiment of the present invention, electrically actuatable valves (6, 7) are directly and ~~coupled~~ mechanically coupled with the manual actuating elements, which ~~here again are designed as in this instance are~~ momentary-contact switches (18, 19), and ~~in addition~~ which can be manually actuated via the manual actuating elements. ~~Hereby~~ As a result, there is achieved ~~a further improvements in~~ terms of compactness and manufacturing costs of valve device (1) are achieved. In this case, valves (6, 7) can be actuated optionally by their momentary-contact switches (18, 19) ~~respectively or, alternatively, by their electromagnets (20, 21) respectively.~~ In each either case, the valves are actuated to counteract against a spring force.

In Fig. 3 ~~there is illustrated~~ depicts a further configuration of the air-suspension device illustrated in Fig. 1 and Fig. 2, however, only the part of the air-suspension device

concerning valve device (1) ~~being~~ is shown as a detail in Fig. 3. The other parts of the air-suspension device correspond to Fig. 1 or Fig. 2.

~~According to~~ Referring now to Fig. 3, there are provided, as electrically actuatable valves, are provided preferably as two 2/2 directional control valves (32, 33), which by analogy with the illustration of Fig. 1 can be actuated by electronic control unit (5) via electromagnets (20, 21) and electrical lines (8, 9). As m Manually actuatable valves there are further provided two as 2/2 directional control valves (34, 35), which can be manually actuated via the already mentioned momentary-contact switches (18, 19). Valves (32, 33, 34, 35) are in communication on the input side with compressed-air port (54), which in all cases of application of valve device (1) is to be placed in communication with compressed-air source (2).

~~According to an advantageous configuration an embodiment of the present invention, a servo-valve device (30, 31) is additionally provided in (Fig. 3) for admission of air to and/or venting of air from air-suspension bellows (3). This s~~ Servo-valve device (30, 31) can be actuated at least by electrically actuatable valves (32, 33), and by manual actuation—In addition, servo-valve device (30, 31) can be manually actuated indirectly via compressed-air actuation by directional control valves (34, 35) in this case—of manual actuating elements (18, 19).

~~Servo-valve device (30, 31) is composed of a~~ includes 2/2 directional control valve (30) that can be actuated by pressurized fluid and of a 3/2 directional control valve (31), both of which that can also be actuated by pressurized fluid. Valve (30) acts as the a holding valve and valve (31) acts as the a combined inlet/outlet valve, t The functions of valves (30, 31) corresponding correspond respectively to the functions of already explained valves (6, 7)

described above with respect to ~~valves (6, 7)~~ of Fig. 1. In contrast to valves (6, 7), however, valves (30, 31) can be actuated by the pressurized fluid, via ~~respective~~ pressurized-fluid control inputs. The pressurized-fluid control input of Hholding valve (30) is in communication via its pressurized-fluid control input with pressurized-fluid outputs of valves (32, 34). The pressurized-fluid control inputs of inlet/outlet valve (31) is in communication with pressurized-fluid outputs of valves (33, 35). Via compressed-air line (13), valve (30) is in communication with compressed-air port (52), which ~~is to be placed~~ may be in communication with compressed-air source (2) or with air-suspension valve (53), depending on the particular application.

Control of the relative level by appropriate action on electrically actuatable valves ~~device (32, 33) takes place~~ is as already described above with respect to Fig. 1. ~~In the process,~~ Electrically actuatable valves (32, 33) act as pilot-control valves for valves (30, 31), respectively. For manual actuation, again as already described with respect to Fig. 1, momentary-contact switch (18) is ~~to be manually actuated~~ for admission of air into air-suspension bellows (3), while momentary-contact switch (19) is ~~to be manually actuated~~ for venting air from air-suspension bellows (3). ~~In the process, v~~ Valves (34, 35) also act as pilot-control valves for valves (30, 31), respectively. ~~During admission of~~ To supply air to air-suspension bellows (3), compressed-air flows from compressed-air source (2) via compressed-air lines (13, 15, 17) to air-suspension bellows (3). ~~During venting~~ To vent air, compressed-air flows from air-suspension bellows (3) via compressed-air line (17) and a venting port of inlet/outlet valve (31) into the atmosphere.

In the case of application of valve device (1) containing an air-suspension valve (53), and when the vehicle is stationary, electronics module (5) switches valve (30) to shutoff

position by non-actuation of electrically actuatable valve (32), ~~so that disabling~~ air-suspension valve (53) ~~is disabled~~. If the vehicle is in travel mode, electronics module (5) switches valve (30) to passing position by actuation of electrically actuatable valve (32), so that air-suspension valve (53) is placed in communication with air-suspension bellows (3) and can bring about regulation of the level of the vehicle body. Electrically actuatable valve (33) is not used in this application of valve device (1).

~~In Fig. 4 there is illustrated~~ illustrates a further advantageous ~~configuration embodiment~~ of the inventive air-suspension device, showing only the part of the air-suspension device concerning the valve devices ~~being shown, as in the case of Fig. 3. The other parts of the air-suspension device correspond to Fig. 1 or Fig. 2.~~

~~In the configuration according~~ Referring to Fig. 4 there is provided, as the servo-valve device, a relay-valve device (40), which ~~has the characteristic that it outputs the pressure present at a pressure-control input (43) to a compressed-air output (42), while maintaining the same pressure head.~~ For the purpose of venting compressed air from air-suspension bellows (3) into the atmosphere, relay-valve device (40) is provided with a vent port. To supply compressed air to air-suspension bellows (3), relay-valve device (40) is in communication, by means of a pressurized-fluid input port (41) and via compressed-air line (13), with compressed-air port (54), which in all cases of application of valve device (1) ~~is to be placed~~ in communication with compressed-air source (2).

~~As shown~~ illustrated in Fig. 4, the electrically actuatable valves are configured as a combined air-admission/holding valve (44), which is ~~designed as~~ preferably a 3/2 directional control valve, and ~~also as~~ a vent valve (45), which is ~~designed as~~ preferably a 2/2 directional

control valve, ~~which~~ The valves can be actuated by electronic control unit (5), via electromagnets (20, 21) ~~respectively~~. ~~By analogy with the aforesaid electrically actuatable valve device,~~ The manually actuatable valve device is also provided with a combined air-admission/holding valve (46), which is ~~designed as~~ preferably a 3/2 directional control valve, as well as ~~with~~ and a vent valve (47), which is ~~designed as~~ preferably a 2/2 directional control valve, ~~which~~ The valves can be manually actuated by momentary-contact switches (18, 19) ~~respectively~~. By means of a pressurized-fluid input port, electrically actuatable air-admission/holding valve (44) is in communication with compressed-air port (52). By means of a pressurized-fluid input port, manually actuatable air-admission/holding valve (46) is in communication via compressed-air line (13) with compressed-air port (54). Via vent valve (45), vent valve (47), air-admission/holding valve (46) and air-admission/holding valve (44), pressure-control input (43) of relay-valve device (40) is looped back to compressed-air output (42) of relay-valve device (40). If electrically actuatable valves (44, 45) and manually actuatable valves (46, 47) are not actuated, as illustrated in Fig. 4, pressure-control input (43) and compressed-air output (42) of relay-valve device (40) are in communication with one another. As a result, relay device (40) exerts a pressure-holding function, ~~to the effects~~ such that the pressure present in compressed-air line (17) is held constant.

In the case of application of electronically ~~controlled~~ level regulation, and air is to be admitted to air-suspension bellows (3), electronic control unit (5) ~~exercises~~ performs the level-regulating functions by acting via electrical line (8) on electromagnet (20) to actuate valve (44). ~~Hereby~~ As a result compressed air is delivered from pressurized-fluid source (2) to pressure-control input (43). Relay-valve device (40) ~~attempts~~ proceeds to adjust the pressure at

compressed-air output (42) to that present at pressure-control input (43), ~~by the fact that~~ using relay-valve device (40) ~~passes to pass~~ compressed air from pressurized-fluid input port (41) through to compressed-air output (42). If air-suspension bellows (3) are to be vented, electronic control unit (5) actuates electromagnet (21) via electrical line (9) in order to actuate valve (45). ~~Hereby~~ As a result, pressure-control input (43) of relay-valve device (40) is placed in communication with the vent port of vent valve (45) and therefore with the atmosphere. Relay-valve device (40) ~~attempts~~ proceeds to adjust the pressure at compressed-air output (42) to that present at pressure-control input (43), ~~by the fact that~~ using relay-valve device (40) ~~allows to~~ allow compressed air to flow out of air-suspension bellows (3) via the vent port of relay-valve device (40) into the atmosphere.

For a manual change of the relative level, momentary-contact switch (18) is ~~to be~~ actuated ~~for admission of~~ to admit air into air-suspension bellows (3) and momentary-contact switch (19) is ~~to be actuated for venting of~~ to vent air from air-suspension bellows (3). ~~In the process, the~~ The actuation of momentary-contact switch (18) ~~brings about a reversal of~~ reverses air-admission/holding valve (46) ~~to the effects such~~ that pressure-control input (43) of relay-valve device (40) is placed in communication with pressurized-fluid source (2). In turn, relay-valve device (40) ~~attempts~~ proceeds to adjust the pressure at compressed-air output (42) to the pressure present at pressure-control input (43), ~~by the fact that~~ using relay-valve device (40) ~~passes to~~ pass compressed air from pressurized-fluid input port (41) through to compressed-air output (42). Actuation of momentary-contact switch (19) ~~brings about a reversal of~~ reverses vent valve (47) ~~to the effects such~~ that pressure-control input (43) of relay-valve device (40) is placed in communication with the vent port of vent valve (47). In turn, relay-valve device (40)

~~attempts~~proceeds to adjust the pressure at compressed-air output (42) to the pressure present at pressure-control input (43); ~~by the fact that~~ using relay-valve device (40) ~~allows to allow~~ compressed air to flow out of air-suspension bellows (3) via the vent port of relay-valve device (40) into the atmosphere.

In the case of application of the ~~mechanically-operating-controlled level-regulating control~~ device containing an air-suspension valve, air-suspension valve (53) is ~~again~~ connected to compressed-air port (52) in the embodiment according to Fig. 4. In this case, air-suspension valve (53) brings about level regulation by changing the pressure at pressure-control input (43) while valve (44) is switched to passing position.

According to ~~an advantageous configuration~~ an embodiment of the present invention, servo-valve device (30, 31, 40) is mechanically coupled with manual actuating element (18, 19) and can be manually actuated via manual actuating element (18, 19). In the ~~case of the configuration~~ embodiment of the servo-valve device according to Fig. 3, the manual actuating elements can be mechanically coupled with valves (30, 31) ~~respectively, meanings such~~ that momentary-contact switch (18) is mechanically coupled with valve (30) and momentary-contact switch (19) with valve (31). In the ~~case of the configuration~~ embodiment of the servo-valve device according to Fig. 4, the manual actuating elements can be directly coupled mechanically with relay-valve device (40). This means, for example, that they can act mechanically from opposite sides on a relay piston provided in relay-valve device (40).

According to ~~an advantageous improvement~~ an embodiment of the present invention, electronically controlled level-regulating device (1) is suitable for receiving at least one manually predefined input variable, ~~to be predefined manually, in which case t~~ The input

variable can be predefined via manual actuating element (18, 19) even in the presence of power supply to electronically controlled level-regulating device (1). Such an input variable is preferably a manually predefined relative level or change of relative level compared with the previously adjusted relative level. This has the advantage that these same actuating elements can be used at any time to predefined the input variable, regardless of whether or not the level-regulating device is being supplied with electrical power. Additional actuating elements such as electric momentary-contact switches are not necessary. Furthermore, a simple kind of operator control is achieved ~~hereby, since because~~ an the operator does not have to ~~make sure of~~ actuatingactuate different operating elements ~~according to~~ based on the state of the power supply.

According to an ~~advantageous improvement~~ embodiment of the present invention, electronically-controlled level-regulating device (1) is ~~suitable for~~ capable of receiving at least one distance signal from a displacement sensor (22) as well as one pressure signal from a pressure sensor (23). Level-regulating device (1) or electronic control unit (5) evaluates the distance signal and the pressure signal continuously, and on the basis of the variation of these signals detects whether an input variable such as a change of relative level has been manually predefined-manually. In the process, electronic control unit (5) advantageously checks whether the distance signal is changing while the pressure signal remains substantially constant. This is an indication of a manually predefined change of relative level, ~~to the effect~~ such that a certain quantity of air has been discharged from or injected into air-suspension bellows (3) at substantially constant vehicle weight. Since it can be assumed during such a manual change of relative level that the vehicle cargo and therefore the vehicle weight remained constant, the pressure in air-suspension bellows (3) does not change as a result, but instead only the volume of

compressed air stored therein is changed by a change in relative level. However, if the electronic control unit detects that the pressure signal and the distance signal are changing, this is an indication that the vehicle cargo has been changed. In this case, electronic control unit (5) does not ~~infer-read~~ a manually predefined input variable.

The exemplary valve devices ~~according to~~ illustrated in Fig. 3 and Fig. 4 are both applicable ~~both in a mechanically-controlled operating-level-regulating device containing an air-suspension valve and in an electronically-controlled level-regulating device.~~

According to an ~~advantageous configuration~~ embodiment of the present invention, a rotary arm known from conventional rotary slide valves can ~~also be used instead of two~~ separate momentary-contact switches (18, 19). ~~The~~ is rotary arm ~~brings about admission of~~ supplies air to air-suspension bellows (3) in one end position and ~~venting of~~ vents air from air-suspension bellows (3) in another end position.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained, and since certain changes may be made in the above constructions without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is: